

Areawide Waste Treatment and Water Quality
Management Planning. Soil Erosion
Potential of Reclaimed Agricultural Lands

Greater Egypt Regional Planning and Development
Commission, Carbondale, IL

Prepared for

Environmental Protection Agency
Chicago, IL

Dec 80



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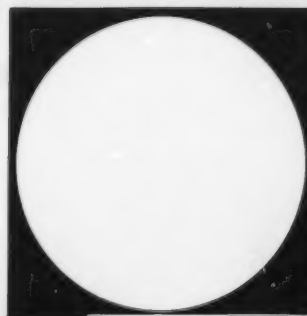
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Areawide Waste Treatment And Water Quality Management Planning

Soil Erosion Potential Of Reclaimed Agricultural Lands

Franklin, Gallatin, Hamilton, Hardin,
Jackson, Jefferson, Perry, Pope, Saline,
and Williamson Counties, Illinois



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608 east college st. / carbondale, illinois / area code 618 549-3306
mailing address: post office box 3160 / carbondale, illinois / 62901

December 1980

William Kelley, Chairman
Greater Egypt Regional Planning
and Development Commission

Lloyd Williams, Chairman
Southeastern Illinois Regional Planning
and Development Commission

Transmitted herewith is the Soil Erosion Potential of Reclaimed Agricultural Lands report. This document addresses the surface-mined land in Perry County and relates their soil erosion loss to water quality in area streams.

The report is an integral part of the Water Quality Management Planning Program, and refines issues developed in the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois. It is designed to meet the contract requirements of Federal Grant P005461-01 with the United States Environmental Protection Agency.

We trust the submittal of this report, as well as others comprising the 208 program, will document the continuing planning activities for water quality management.

Sincerely,

A. S. Kirkikis
Executive Director

ASK:j1

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The Kinkaid-Reed's Creek Conservancy District

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TABLE OF CONTENTS

	<u>Page</u>
Table of Contents	i
List of Tables	i
List of Figures	i
Chapter 1 - INTRODUCTION	1
An Illinois Advantage	1
Surface Mining Laws of Illinois	4
Coal Mining Techniques	5
Chapter 2 - AFFECTED WATER RESOURCES IN ILLINOIS	9
Affected Stream Mileage in Perry County	10
Panther Creek Watershed	12
Chapter 3 - COAL RESERVES IN PERRY COUNTY	13
Southern Illinois Soils	13
Perceived Changes Due to Reclamation	16
REFERENCES	19
BIBLIOGRAPHY	21

LIST OF TABLES

Table 1 - Affected Stream Mileage of Perry County	10
Table 2 - Pre-Mining and Post-Mining Land Uses In Perry County	14

LIST OF FIGURES

Figure 1 - Annual Coal Production in Million Tons	3
Figure 2 - Location of Surface Mines in Perry County	11

Chapter 1

INTRODUCTION

The Federal Water Pollution Control Act (Public Law 92-500) asserts that each state should administer its own water quality program in compliance with the Act and national program. In response to this designation, in 1975, the Governor of the State of Illinois designated the ten counties served by the Greater Egypt Regional Planning and Development Commission and the Southeastern Illinois Regional Planning and Development Commission as the Southern Illinois Water Quality Management Area. It was felt that these ten counties: Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Perry, Pope, Saline, and Williamson, which encompass almost the entire Big Muddy and Saline River Basins, had factors affecting water quality which made the area unique in the state and should be addressed locally.

In early 1979, the Areawide Waste Treatment and Water Quality Management Plan For Southern Illinois was finalized and submitted to the Illinois Environmental Protection Agency and the U. S. Environmental Protection Agency. Since that time a myriad of counties, municipalities, soil and water conservation districts and river conservancy districts have endorsed and participated in implementing the Plan. This report documents the findings of the initial Plan and the continuing planning process under Section 208 of the Federal Pollution Control Act as amended.

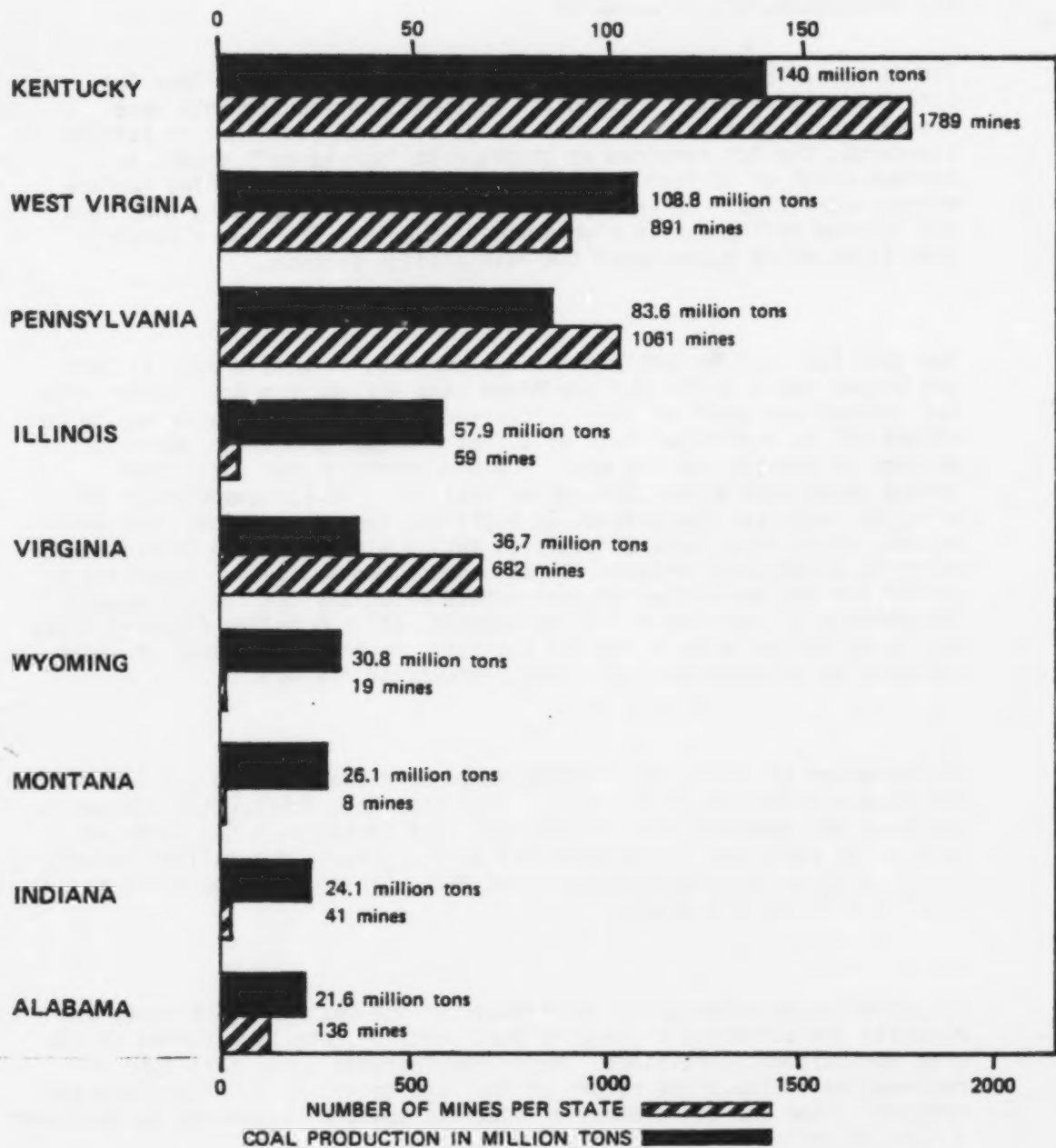
An Illinois Advantage

Illinois enjoys unique advantages that make mining its coal more environmentally acceptable than mining in most regions of the country. The abundance of extractable coal reserves and favorable water resource conditions in major mining areas is unique to Illinois, and more conducive to economical and environmentally sound coal production than that found in other states. Large, continuous and extractable ore deposits, along with vast industrial mineral holdings, have encouraged the development of many large mines in Illinois. Eastern states, Pennsylvania and West Virginia for example, have hundreds of small mines producing less than double the coal produced by 59 mines in Illinois (Figure 1). Illinois

mines take advantage of the economies of large scale operations, which provide more efficient use of new extraction and reclamation technologies. These large companies also benefit from greater financial resources, which provide environmental staffing and expertise not feasible for small mining operations.

Records indicate that a total of 201,105 acres have been affected through June 30, 1978, by surface mining for coal in Illinois. Of this total, 103,181 acres were affected prior to the existence of any surface mining and reclamation law in the state. The remaining 97,924 acres have been affected, under permit since January 1, 1962, when the first surface mining and reclamation law became effective.¹

FIGURE 1
ANNUAL COAL PRODUCTION
IN MILLION TONS



Note: Graph is composite of most recent data available.

Source: Illinois Environmental Protection Agency, An Illinois Environmental Issue: Water Resources and Coal Mining.
Bulletin No. 1, 1978.

Surface Mining Laws of Illinois

The first surface mining act in Illinois was known as the Open Cut Land Reclamation Act. Grading and revegetation requirements were minimal under this Act. As an example, on lands reclaimed to pasture standards, the Act required an operator to "strike off" grade, to a minimum width of 10 feet, all ridges and peaks created during surface mining activities. In addition, operators were required to then seed the "strike off" areas in a workmanlike manner. There were specific provisions which guaranteed the revegetation success.

The Open Cut Land Reclamation Act was amended, effective July 1, 1968, and became known as the Surface Mined Land Reclamation Act. Under this Act, ridges and peaks of lands reclaimed to pasture standards had to be struck off to a minimum width of 8 feet and seeded with an approved mixture of grasses and legumes. Minimum standards for vegetative ground cover were established under this Act. Thus, revegetation of affected lands was guaranteed. In addition, the Act provided that toxic waters, which might have accumulated during mining, had to be eliminated prior to surety bond release. It also contained provisions requiring a permit for the deposition of coal refuse materials and the subsequent reclamation of such areas. As an example, all gob refuse disposal areas had to be buried under 4 feet of non-toxic materials, capable of being revegetated in accordance with requirements of the Act.

On September 17, 1971, the Surface Mined Land Conservation and Reclamation Act became effective in Illinois. With this Act, substantial changes in reclamation standards were introduced. For instance, mined lands which were to be reclaimed for pasture had to "be graded to a rolling topography traversable by machines necessary for maintenance", with no slope exceeding a 15 percent grade.

A further stipulation gave the Director of the Department of Mines and Minerals the authority to require that certain lands be returned to row crop agricultural conditions. Major requirements under this type of reclamation included the return of the land to within 4% of its average original slope and achievement of specific textural standards in the upper 4 feet of reclaimed lands.

The Surface-Mined Land Conservation and Reclamation Act was amended July 1, 1975, to include even more stringent requirements, particularly on lands reclaimed to row crop agricultural standards. The Illinois law, with its amendments to date, requires in general that the land be back filled and graded to very nearly the original contours where the land was used for row cropland. The same is to be done with land whose soil and slope characteristics make it suitable for row crop use as shown by soil conservation service surveys, regardless of former land use. A minimum of 8 inches and a maximum of 18 inches of surface soil must be segregated and replaced under these requirements. In addition, the amended Act required that the material below the darkened surface soil be suitable as an "agricultural root medium". The surface soil layer and root medium layer together must be a minimum of 4 feet thick. Pasture and haylands not suitable for row crop must be graded so that no slope exceeds 15%; and forest and wildlife areas, if not suitable for row crop, graded so that no slope exceeds 30%. The final cut highwall must be reduced to a 50% slope or less. Operators are also required to restore drainage to its original pattern where this is possible. Re-vegetation of all reclaimed land according to its intended use is required by this reclamation act. For details see Rules and Regulations, Surface-Mined Land Conservation and Reclamation Act as amended in 1977.

Other state reclamation acts contain additional requirements that would improve on the water quality protection provided by Illinois law. Some examples are: 1) a time limit of one year for complete revegetation as required in Iowa; 2) revegetation with primarily natural species as required in Montana; and 3) reduction of highwall to less than 50% slope (in Missouri 20% is required and in Maryland and Pennsylvania the highwall must be "eliminated").

Coal Mining Techniques

Coal is mined in the 208 area using both underground and surface mining techniques. Underground mining in the area is primarily by shaft mines (i.e., mines which gain access to coal layers through a vertical shaft through the overburden). The surface remains undisturbed in this kind of mining except for the processing plant location. At the processing location, surface acreage comes in contact with pyritic waste materials separated from the coal by washing and other processes.

Coal from layers more than 100 feet in depth is mined in the 208 area by surface mining techniques. A brief description of the major types of surface mining equipment utilized in Illinois mining and some elementary explanation may help the reader in reviewing the various tables and data presented. The majority of the surface mined acreage in the state is mined by dragline, wheel and shovel, or shovel,

The dragline is noted by many experts to be one of the more versatile of the major types of surface mining equipment. The selectivity of this machine (under certain Illinois conditions) allows undesirable materials, such as large rocks or acid-producing strata to be adequately buried by finer-textured, non-acid producing overburden materials. The resulting surface texture and quality of graded lands should, therefore, be more conducive to production of agricultural crops than would lands containing considerable amounts of large rock or acid producing material. However, as past experience has shown, using the dragline technique does not insure that the final texture of graded lands will meet the textural standards of the Illinois laws currently in effect. In many cases, the use of pan scrapers is necessary for placement of finer-textured soil materials to meet "root medium" requirements.

A second technique in common practice in Illinois is the use of a wheel excavator and mining shovel used in a tandem operation. Unconsolidated overburden materials are handled by the wheel and placed above the coarser materials handled primarily by the shovel. The resultant surface texture on graded lands is generally considered tillable.

The third common technique for overburden removal is the use of the mining shovel. The ability of a shovel to selectively cast overburden is severely limited by its design. In Illinois, overburden removed by a shovel will often contain considerable amounts of large rock in the surface after grading is completed. As in the case with many dragline operations, the use of pan scrapers is necessary to achieve proper placement of "root medium" materials.

Large amounts of land acreage are disturbed in the surface mining procedures. This, plus preparation plant refuse, constitutes a dual potential for water quality degradation from surface mining for coal. The preparation of coal for consumer use varies somewhat according to its intended use in terms of the final size of coal pieces desired and special treatment applied. Most coal mined in the 208 area is destined for use in electric power generation. In general, processing of the raw

coal includes: 1) storage to accommodate irregular flow of raw material from the mine; 2) crushing using rotary breakers, roll type crushers, hammer mills, etc. in one or several steps; 3) screening to sort various sizes; 4) washing with heavy media cleaning, hydrorotator, washing table, or froth flotation plants, according to size and intended use; and 5) dewatering and/or drying.

Chapter 2

AFFECTED WATER RESOURCES IN ILLINOIS

Early Illinois mining activity did not place importance on maintaining quality water and land resources. An inventory of problem sites in surface-mined lands indicates that by 1978, 201,105 acres (.55 percent of the state's area) had been affected by strip mining operations, and that the acreage was increasing at a rate of approximately 6,000 acres per year. Approximately 20,100 acres (10 percent) of these affected lands were identified as problem areas representing actual or potential sources of water pollution. Future removal of all strippable reserves would affect approximately 2,600,000 acres (7 percent) of the state's area with some counties having more than 60 percent of their land surface affected.² The last two projections could be expected to increase by 10 - 15% throughout the next 20 years given anticipated improvements in surface mining operations.

Illinois streams in coal mining areas are not recognized as high quality waters when compared to the sensitive cold water trout streams of Pennsylvania, West Virginia, Wyoming, Montana and other states. Rather, they are warm water fisheries, and are not as sensitive to land disturbance as cold water trout streams. This is not to say they are resistant to change by the massive land movements of surface mining. The water quality associated with the more than 340 active and abandoned surface and underground mines causes the Big Muddy and Saline River Basins to represent the worst examples of mine drainage problems in the state. Mine drainage adversely affects 126 miles of streams within the Big Muddy River Basin and 99 miles within the Saline River Basin. These streams are degraded to such a degree that many are completely void of fish and aquatic life or will not continually support aquatic life.³

Affected Stream Mileage in Perry County

In the study area of Perry County it was estimated that 35 miles of streams and tributaries border or flow within one-tenth of a mile of surface mined land. This estimate was derived through map measurements (Figure 2). Listed below are the estimated affected miles for several streams in Perry County.

Table 1
AFFECTED STREAM MILEAGE OF PERRY COUNTY

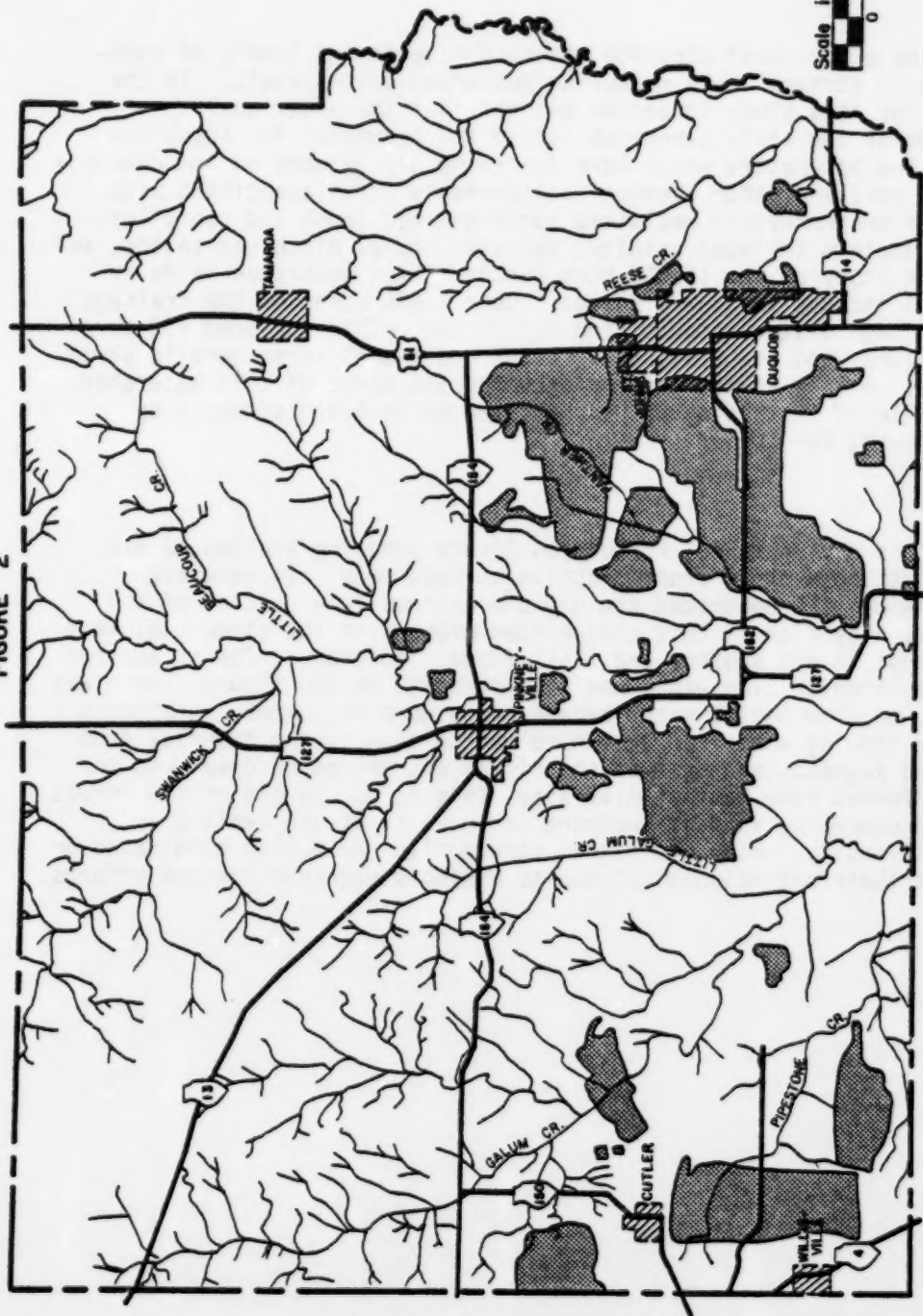
	<u>Main Stream</u>	<u>Tributary</u>
Pipestone Creek	3.4 Miles	9.8 Miles
Galum Creek	2.0 Miles	2.0 Miles
Little Galum Creek	2.0 Miles	-0-
Beacoup Creek	4.8 Miles	3.2 Miles
Panther Creek	2.6 Miles	5.2 Miles

Some Southern Illinois stream systems are generally considered to be of exceptional quality such as Lusk; Grand Pierre; and Big Creek, tributary to the Ohio River and may qualify as Section 522, streams, of the Surface Mining Control and Reclamation Act (P.L. 95-87). However, none of these streams pass through high potential mining areas.

Only minimally usable groundwater resources exist in much of Illinois major mining areas although there is localized use of shallow groundwater for individual households and farms. The natural low yield and poor quality of these groundwater resources preclude major user development in these areas. Preservation of groundwater resources and the hydrologic balance is important to protect existing users and to minimize adverse effects on surface water quality and quantity.

Although modern mining technology and compliance with regulatory programs have reduced the environmental impact of recent mining, the scars of past coal mining practices remain visible in Illinois water resources. Illinois EPA monitoring shows that acid drainage, toxic levels of dissolved minerals, and discoloration are prominent irregular features of more than 400 miles of state waterways.

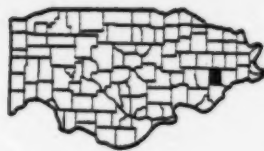
FIGURE 2



LOCATION OF SURFACE MINES IN PERRY COUNTY

LEGEND

- MAJOR HIGHWAYS
- MAJOR CITIES
- STREAMS
- LAND AFFECTED BY SURFACE MINED ACTIVITIES



LOCATION
IN ILLINOIS



Panther Creek Watershed

To date one of the most accurate means of determining levels of sedimentation in streams is by measuring suspended solid levels. In the research for this study it became evident that the water quality monitoring of the early seventies lacked the parameter for suspended solids. The parameters which were tested mainly focused on the determination of acid and other chemical contaminants often associated with drainage from improperly reclaimed surface-mined lands and gob piles. These parameters included acidity, sulfates, total dissolved solids, and iron. One study on the 16,200 acre Panther Creek watershed in Perry County did include suspended solids. Over 4,800 acres of the drainage basin had been disturbed by mining activities. This included 252 acres of gob, slurry and preparation area; 602 additional acres were in strip pit ponds. Active surface mining occupied 345 acres of this watershed. Fully one-third of this watershed had been or is being affected by surface mining for coal.

The Illinois Environmental Protection Agency sampling Station 13 was located just downstream from an active surface mine. It received erosion deposits from graded and ungraded slopes in a portion of the mine area. The flow in this channelized segment of the stream was very small except in wet seasons and flash flood conditions. The stream bed had steep, eroding clay banks and silt deposits on the floor. There was no shade, so slow moving water became quite warm in summer. A stretch of faster flowing water ran over hard packed clay bottom material from the ponded segment, and some of the riffle was shaded by grass, so the stream afforded some habitat diversity. This is an example of the effect increased concentrations of sediment can have on stream habitat and species diversity. Many additional stream miles have been eliminated or have lost their natural habitat due to mining's rechannelization efforts.

Chapter 3

COAL RESERVES IN PERRY COUNTY

Presently, approximately 16% of Perry County's surface acreage has been affected by surface mining operations, and 60% of its surface is underlaid by strippable coal reserves. Given expected improvements in surface mining technologies, these strippable reserves may exceed 80% of the county. Ninety-five percent of this surface is capable of supporting agricultural activities. Records show that a total of 29,430 acres have been affected through June 1978, by surface coal mining in Perry County. Of this total, 13,084 acres were affected prior to the existence of any surface mining and reclamation law in the state. The remaining 16,346 acres have been mined under permit since January 1, 1962, when the first surface mining and reclamation law became effective.

In 1979, the Perry County Soil Conservation Service conducted a county-wide land use inventory (Table 2). The results show that over 6% of the pre-mining cropland was changed to land uses other than cropland. An increase of water, pasture and hayland is evident. The changing of the land surface can have a profound effect on water quality in the surrounding waterways. Soil loss yields from barren, disturbed soils such as uncovered mine lands can exceed 50 tons per acre per year, but to date few experiments with published data pertaining to soil loss from surface mined lands have been released. The land reclaimed under Rule 1104 of the Surface-Mined Land Conservation and Reclamation Act is of major concern to both the mining industry and the agricultural community. These present rules and regulations appeared sufficient when written; but as this project is finding, they may be inadequate in protecting the surface water quality of area streams while the soils themselves may be changing for the worse.

Southern Illinois Soils

Southern Illinois has an "older" soil than the rest of the state. This soil is characterized by its sub-surface fragipan layer. All areas in Illinois have a fragipan layer, but none where it exists as close to the surface as in Southern Illinois. Fragipan is a soil classification

Table 2
PRE-MINING LAND USES IN PERRY COUNTY

<u>Land Use Category</u>	<u>Acres</u>	<u>Percent</u>
Cropland	4,705.2	37.6
Woodland	1,297.3	10.4
Timber & Shrubland	1,328.0	10.6
Pasture & Hayland	3,527.5	28.17
Idle	216.0	2.0
Water	241.1	2.0
Roads	270.2	2.0
Previously Mined	65.8	.5
Wildlife	398.2	3.0
Rangeland	88.0	.7
Vegetation	123.0	1.0
Abandoned Quarry	5.0	.1
Residential	20.5	.4
Previously Affected By Overburden Removal and Deposition	172.0	1.0
Borrow Pit	13.0	.1
Diversion Ditch	3.0	.03
Parking Areas	2.6	.02
Equipment Storage	8.2	.06
Railroads	37.0	.3
Buildings	3.0	.02
Total	12,524.6	

Table 2 (cont.)
POST-MINING LAND USES IN PERRY COUNTY

<u>Land Use Category</u>	<u>Acres</u>	<u>Percent</u>
Cropland	3,951.0	31.2
Woodland	1,020.0	8.0
Timber & Shrubland	681.0	5.0
Pasture & Hayland	3,642.0	29.0
Water	752.8	6.0
Roads	377.5	3.0
Wildlife	800.6	6.0
Rangeland	52.0	.4
Abandoned Quarry	5.0	.04
Area Not Affected By Overburden Removal	1,206.0	10.0
Post Mine Use	3.3	.03
Light Industry	55.4	.4
Outside Boxcut Spoil	14.0	.1
Incline Side Slopes	54.5	.4
Angle of Repose Side Slopes	48.0	.4
30% Final Cut	4.0	.03
Total	12,667.1	

Source: Perry County Soil and Water Conservation District, 1979.

which describes the characteristics of a tightly packed sub-soil. The high density of soil particles creates a media which impedes root penetration, and in turn limits plant growth.

When agricultural land is reclaimed, the top soil and sub-surface soils are removed. In the process of removal, this fragipan is broken apart. Contained in this layer are concentrations of minerals which could be used to improve the soil's ability to support vegetation. Theoretically the disturbance of these soils should greatly improve them. For instance, root penetration is facilitated, more minerals are made available, and water storage capacity is improved. However, in reality this does not seem to be the case.

Perceived Changes Due to Reclamation

When the four foot layer of textured material is replaced, the equipment used (pan scrappers) re-compact the soils. It has been found that several studies are evaluating this change in disturbed soils, and in particular the affect that the heavy equipment has on soil compaction (bulk density). To date, no material has been published in report form which evaluates the results from these tests. From on-site observation by area soil scientists, it appears that a detrimental change in soils can be expected.

By compacting the soil with heavy machinery, several problems are created. The first is that the infiltration of water is inhibited. With water seeping slowly into the soil, more is left to runoff. This accelerates the sheet and rill erosion, which leads to channelization and gulying. Another problem is that the water storage capacity is lowered, which affects plant growth. If the soils are too compacted for efficient root growth and if less water is available to the plant, the ground will have scarce and/or slower growing ground cover. In any event, erosion will be increased leading to a loss of farmable soils and increased sedimentation in streams.

Other indicators of increased soil erosion on reclaimed agricultural land involve plant production rates. With poor water storage and increased runoff, plants find a more harsh environment to grow in. Therefore recent studies on production rates will also need to be evaluated. In this area of study few results have been published about rates of growth

on reclaimed agricultural land, and it would appear that none have researched plant regeneration rates on newly reclaimed agricultural land. Most studies involve crop production and not restabilization of barren reclaimed surfaces.

At this time, one can only speculate as to the extent of the change. Test results should be available by mid-1981. An evaluation of these findings will better prepare management agencies to prescribe more adequate conservation methods. This needs to be accomplished through cooperation with the Illinois Soil Conservation Service office and several research laboratories.

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